

Flux Transport and the Sun's Global Magnetic Field

David H. Hathaway

The Sun's global magnetic field is produced and evolved through the emergence of magnetic flux in active regions and its transport across the solar surface by the axisymmetric differential rotation and meridional flow and the non-axisymmetric convective flows of granulation, supergranulation, and giant cell convection. Maps of the global magnetic field serve as the inner boundary condition for space weather. The photospheric magnetic field and its evolution determine the coronal and solar wind structures through which CMEs must propagate and in which solar energetic particles are accelerated and propagate. Producing magnetic maps which best represent the actual field configuration at any instant requires knowing the magnetic field over the observed hemisphere as well as knowing the flows that transport flux. From our Earth-based vantage point we only observe the front-side hemisphere and each pole is observable for only six months of the year at best. Models for the surface magnetic flux transport can be used to provide updates to the magnetic field configuration in those unseen regions. In this presentation I will describe successes and failures of surface flux transport and present new observations on the structure, the solar cycle variability, and the evolution of the flows involved in magnetic flux transport. I find that supergranules play the dominant role due to their strong flow velocities and long lifetimes. Flux is transported by differential rotation and meridional flow only to the extent that the supergranules participate in those two flows.